
अग्नि संसूचक व संचेतक के लिए नियंत्रण और
सूचक उपस्कर के चुनाव, संस्थापन
व रख-रखाव — रीती सहिता

(पहला पुनरीक्षण)

**Selection, Installation and
Maintenance of Control and
Indicating Equipment for Fire
Detection and Alarm
System — Code of Practice**

(*First Revision*)

ICS 13.220.20

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FOREWORD

This Indian Standard (First Revision) was adopted by the Bureau of Indian Standards, after the draft finalized by the Firefighting Sectional Committee had been approved by the Civil Engineering Division Council.

In fire alarm systems, control and indicating equipment (CIE) are the backbone of the entire network and performs three important functions, namely:

- a) Continuous and automatic monitoring and control of circuits external to the equipment (such as fire detection and fire alarm device circuits) and also supply of power to these circuits.
- b) Indication of fire signals, fault signals and their location.
- c) Manual control to facilitate actions, such as testing, disablement of devices, triggering of fire signals, silencing of audible fire warning and resetting the system after a fire signal.

As these facilities are required by different people at different times, all these facilities need not always be provided at a single location. For example, according to the premises, indication of faults might be required by an engineering personnel, who might not require detailed information on fire signals whereas accurate information on the location of a fire is essential to the safety/security personnel, who might need specific information about system fault(s).

In small and simple systems, the control indicating and power supply equipment for the system is normally housed within a single enclosure. In large and complex premises, the main control equipment circuitry might be installed at one location, power supplies might be distributed around the building, while main indicating equipment incorporating certain basic controls is installed at another location, such as near a main entrance to the building; and lastly, repeat indicating equipment (with or without control) may be installed at other locations (such as security or control rooms).

Since premises vary in size, complexity and fire strategy, it is essential that the nature and location of manual controls and all indicating equipment, in particular, is suitable for the fire and evacuation procedure that are to be adopted and for the person that shall use the system, including security or safety staff and fire-fighter attending a fire. Location of control circuitry and power supplies shall more likely to be determined by engineering considerations and the preference of the personnel who are going to use the system. This standard was formulated in 2011 to address all the above and lay down the planning, design, maintenance and performance requirements of CIE to detect fire and raise alarm thereon.

In this revision, the following major changes have been made:

- a) Detailed generic information on control and indicating equipment have been included.
- b) Requirements about control and indicating equipment have been included, in detail.
- c) Terminology has been updated.
- d) All references to the cross referred Indian Standards have been updated and the list made comprehensive.

The composition of the Committee responsible for the formulation of this standard is given in Annex E.

For the purpose of deciding whether a particular requirement of this standard is complied with the final value observed or calculated, expressing the result of a test or analysis shall be rounded off in accordance with IS 2 : 1960 'Rules for rounding off numerical values (*revised*)'. The number of significant places retained in the rounded off value should be the same as that of specified value in this standard.

Indian Standard

SELECTION, INSTALLATION AND MAINTENANCE OF CONTROL AND INDICATING EQUIPMENT FOR FIRE DETECTION AND ALARM SYSTEM — CODE OF PRACTICE

(*First Revision*)

1 SCOPE

1.1 This standard covers planning, design, maintenance and performance criteria for control and indicating equipment for fire detection and alarm systems.

1.2 This standard covers minimum level of protection. Nothing in this standard prevents to install systems designed for higher degree of protection, for special risks, etc.

2 REFERENCES

The standards listed at Annex A contain provisions which through reference in this text, constitute provisions of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards.

3 TERMINOLOGY

For the purpose of this standard, the terminology in IS 8757 and the following shall apply.

3.1 Access Level — One of several states of a control and indicating equipment (CIE) in which selected:

- a) controls can be operated;
- b) manual operations can be carried out;
- c) indications are visible; and
- d) information can be obtained.

3.2 Acknowledge — To confirm that a message or signal has been received, such as by the pressing of a button or the selection of a software command.

3.3 Active Multiplex System — which signaling devices, such as transponders are employed to transmit status signals of each initiating device or initiating device circuit within a prescribed time interval so that the lack of receipt of such a signal can be interpreted as a trouble signal.

3.4 Addressable Device — A fire alarm system component with discrete identification that can have

its status individually identified or that is used to individually control other functions.

3.5 Addressable Point — Point which can be individually identified at the CIE.

3.6 Alert Tone — An attention-signal to alert occupants of the pending transmission of a voice message.

3.7 Alphanumeric Display — Indicator capable of giving information by the display of the messages consisting of text and/or numeric characters.

3.8 Annunciator — A unit containing one or more indicating lamps, alphanumeric displays or other equivalent means in which every indication provides status information about circuit location or condition.

3.9 Average Ambient Sound Level — The term average ambient sound level is also called the equivalent A-weighted sound level measured over t hours, where t is the time period over which the measurement is made.

3.10 Confirmation Signal — Signal from a fire detector or manual call point which terminates a first alarm state.

3.11 Detection Circuit — Transmission path which connects various points to CIE.

3.12 Earth Fault — Unwanted connection between earth potential and any part of the CIE or transmission paths between parts of the CIE.

3.13 Fire Alarm Control Panel (FACP) — A component of the fire alarm system, provided with primary and secondary power sources, which receives signals from initiating devices or other fire alarm control units, and processes these signals to determine part or all of the required fire alarm system output function(s).

In addition to the functions mentioned above, FACP may also have an integral operator interface, supply power to detection devices, notification appliances, transponder(s), or off-premises transmitter(s) or any combination of these. The control unit might

also provide transfer of condition to relay or devices connected to the control unit. There can be multiple fire alarm control units in a fire alarm system.

3.14 First Alarm Signal — Signal from a fire detector or manual call point which is interpreted as a fire alarm, but following which the CIE enters a first alarm state.

3.15 First Alarm State — State of the CIE following the receipt of a first alarm signal during which mandatory functions of the CIE may be inhibited.

3.16 Functional Condition — Condition of the CIE characterized by its indication at the CIE as follows:

3.16.1 Disabled Condition — A condition when the disablement of functions is indicated.

3.16.2 Fault Warning Condition — Condition when a fault is indicated.

3.16.3 Fire Alarm Condition — Condition when a fire alarm is indicated.

3.16.4 Quiescent Condition — Condition when no other functional condition is indicated when power supply is on for the CIE.

3.16.5 Supervisory Signal Condition — Condition when a supervisory signal is indicated.

3.16.6 Test Condition — Condition when the testing of various functions are indicated.

3.17 Impairment — An abnormal condition where a system, component, or function is out of order and the condition can result in the system or unit not functioning when required.

3.18 In-Building Fire Emergency Voice/Alarm Communications System — Dedicated manual or automatic equipment for originating and distributing voice instructions, as well as alert and evacuation signals pertaining to a fire emergency, to the occupants of a building.

3.19 In-Building Mass Notification System — A system used to provide information and instructions to people in a building(s) or other space using intelligible voice communications and including visible signals, text, graphics, tactile, or other communication methods.

3.20 Indicator — A device that can change its state to give information.

3.21 Indication — Information provided by an indicator.

3.22 Mandatory — Qualification applied to those functions required to be provided on all CIE and the function's requirements and to the requirements of any optional functions that have requirements, if such optional functions are provided.

3.23 Multiplexing — A signaling method characterized by simultaneous or sequential transmission, or both, and reception of multiple signals on a signaling line circuit, a transmission channel, or a communications channel, including means for positively identifying each signal.

3.24 Non-volatile Memory — Memory elements which do not require the presence of energy source for the retention of their contents.

3.25 Notification Appliance — A fire alarm system component, such as a bell, horn, speaker, light, or text display that provides audible, tactile, or visible outputs, or any combination thereof.

3.26 Point — Component connected to a detection circuit able to transmit or receive information in relation to fire detection.

3.27 Program — Software necessary for a CIE to comply with at least the requirements of this standard, including initializing data, reset and interrupt vectors, operating code and declarations.

3.28 Public Address System — An electronic amplification system with a mixer, amplifier, and loudspeakers, used to reinforce a given sound and distributing the 'sound' to the general public around a building.

3.29 Reset — Operation capable of terminating the fire alarm condition and/or the fault warning condition.

3.30 Response — Actions performed upon the receipt of a signal.

3.31 Running Data — Alterable data subject to temporary modification during operation, either automatically or by manual controls.

3.32 Silencing — Manual operation for switching off the audible signal of a sounding device which is capable of being automatically sounded by the new event.

3.33 Site-specific Data — Alterable data required for the CIE to operate in a defined system configuration.

3.34 Supervising Station — A facility that receives signals from protected premises fire alarm system and at which personnel are in attendance at all times to respond to these signals.

3.35 Transmission Path — Connection external to the cabinet of CIE for transmission of information and/or power:

- a) between the CIE and other components of a fire detection and fire alarm system; and
- b) between parts of CIE contained in different cabinets.

3.36 Volatile Memory — Memory elements which require the presence of an energy source for the retention of their contents.

3.37 Window — Part of an alphanumeric display used for information relating to one functional condition at a given time.

3.38 Wireless Network — The method of communications used in a public emergency alarm reporting system when it consists of a wireless type of communications infrastructure.

3.39 Wired Network — The method of communications used in a public emergency alarm reporting system when it consists of a wired type of communications infrastructure.

3.40 Zone — Geographical sub-division of the protected premises in which one or more points are installed and for which a common zonal indication is provided.

4 ABOUT CONTROL AND INDICATING EQUIPMENT (CIE)

4.1 In fire alarm systems, control and indicating equipment (CIE) are the backbone of the entire network which perform three important functions, namely:

- a) Continuous and automatic monitoring and control of circuits external to the equipment (such as fire detection and fire alarm device circuits) and also supply of power to these circuits.
- b) Indication of fire signals, fault signals and their location.
- c) Manual control to facilitate actions, such as testing, disablement of devices, triggering of fire signals, silencing of audible fire warning and resetting the system after a fire signal.

4.2 As these facilities are required by different people at different times all these facilities need not always be provided at a single location. For example, according to the premises, indication of faults might be required by an engineering personnel, who might not require detailed information on fire signals whereas accurate information on the location of a fire is essential to the safety/security personnel, who might need in specific information about system fault(s). Hence, annunciation of events, such as alarm, trouble and supervisory indications need to be located to alert the respective responsible responders. For example, it shall be permissible to direct trouble events to engineering personnel while alarm events are located to safety/security personnel.

4.3 In small and simple systems, the control indicating and power supply equipment for the system normally is housed within a single enclosure. In large and complex premises, the main control equipment circuitry might

be installed at one location, power supplies might be distributed around the building, while main indicating equipment incorporating certain basic controls is installed at another location, such as near a main entrance to the building and/or lastly repeat indicating equipment (with or without control) may be installed at other locations (such as security or control rooms). Ideally main control and indicating equipment should be networked with multiple control unit distribution panels located throughout the protected premises.

4.4 Since buildings vary in size, complexity and fire strategy, it is essential that the nature and locating of manual controls and all indicating equipment, in particular, is suitable for the fire and evacuation procedure that are to be adopted and for the person that will use the system, including security or safety staff and fire-fighter attending a fire. Location of control circuitry and power supplies will more likely to be determined by engineering considerations and the preference of the personnel who are going to use the system.

5 LOCATION OF CONTROL AND INDICATING EQUIPMENT

5.1 The following requirements shall receive attention by the user and installers before locating CIE:

- a) Since the CIE is essential for the operation of the system, it shall be placed in an area of low fire hazard. In a complex building with multiple entrances, it may be necessary to provide repeat indicator panel(s) at the building entry point(s) to be used by the fire authorities.
- b) CIE, in conjunction with suitable manual controls should be sited at an appropriate location for both staff and fire-fighters responding to a fire signal. This should normally be an area on the ground floor close to the entrance of the building likely to be used by the fire service, or a suitably sited, continuously manned control room or from which at least initial control of any fire incident, by safety staff and/or the fire fighters, will be implemented.
- c) The ambient light level in the vicinity of all CIE shall be such that individual indications can be clearly seen, controls easily operated and any instructions or legends can be easily read. Where this is impracticable, suitable illumination backed up by an emergency source shall be made available.
- d) Noise or other sound levels in the vicinity of the control equipment shall not dilute the audible alarm given by the CIE (such as the fault warning sounder) from being heard.
- e) In complex premises, there shall be consultation between the user, installer and the fire fighters, regarding the location of all CIE and the facilities provided.

- f) In buildings which are not continuously occupied, location of CIE shall be such that it will be visible to the fire brigade from outside the building that can be of benefit, particularly if there is a facility for transmission of alarms to an alarm receiving centre.

5.2 All control indicating and power supply equipment that is likely to need routine attention for maintenance shall be located in readily accessible locations that facilitate safe maintenance work.

5.3 CIE, power supply equipment for the CIE and other essential control facilities shall be located in safe areas, so that the equipment is unlikely to be involved in a fire before adequate warning has been given.

5.4 It is preferable to provide detection system for the enclosure where CIE is installed though it is compulsory if installed in a part of the protected building.

5.5 On or adjacent to the CIE, there shall be a diagrammatic representation of the building showing at least the building entrance, the main circulation area and the division into zones. Where the division into zones is not provided, a correctly orientated plan of the premises shall be displayed.

6 GENERAL REQUIREMENTS FOR THE CONTROL AND INDICATING EQUIPMENT (CIE)

6.1 Configuration

6.1.1 The CIE shall form the central processing unit of the system, receiving and analyzing signals from initiating devices, providing audible and visual information to the user or initiating automatic alarm response sequences and providing the means by which the user interacts with the system.

6.1.2 The CIE shall be modular in construction, where appropriate, to allow for future extension of the system.

6.1.3 The CIE shall be easily configurable so as to meet the exact detection zone and output mapping requirements of the building, and also to provide for revisions due to change in layout of the premises, if required.

6.1.4 The CIE shall be microprocessor based and operate under a multitasking software program. Operating programs and configuration data must be contained in easily up-datable non-volatile memory.

6.1.5 The CIE shall incorporate a real-time clock to enable events to be referenced against time and date. This clock shall be accurate to within 1 min/year under normal operating conditions.

6.1.6 It shall be possible for technical staff to perform configuration updates on site by plugging a portable personal computer into the CIE. Configuration data shall be retained on the personal computer's hard drive and be capable of being backed up on to a central storage system. It shall also be possible, providing a responsible person is present at the CIE, for updates to be downloaded from a remote location over TCP/IP.

6.1.7 In order to facilitate re-configuration and system extension, the user must (after suitable training) be able to carry out the following functions from the front of the CIE:

- a) Change panel text,
- b) Change zone text,
- c) Change sector text (for networked systems),
- d) Change individual point text,
- e) Add addressable devices,
- f) Delete addressable devices,
- g) Modify addressable devices, and
- h) Change individual point addresses.

6.1.8 The company responsible for the installation shall operate an approved document control system for the retention of configuration data.

6.1.9 The CIE shall comprise separate processors, cross-monitoring each other's correct operation, for the major functions of the systems. In particular, different processors must be used for main control function, detection input and alarm output functions, and display and control function.

6.1.10 The controller shall have the capacity to run up to 1 000 addressable devices.

6.1.11 The address code for each addressable device shall be held within the addressable device (that is, detector head, ancillary module, call point, etc).

6.1.12 Programming of the address code shall be through either the CIE or a dedicated programming tool.

6.1.13 The CIE shall incorporate a key switch to prevent unauthorized use of the manual controls.

6.1.14 The CIE shall have an on-board LCD display (or the like) with not less than 16 lines of text.

6.1.15 The CIE shall be capable of operating with conventional detectors, digital addressable detectors, intrinsically safe conventional detectors and digital addressable detectors suitable for installation in hazardous areas and all modules, hooters, isolators, etc.

6.1.16 Addressable input and output devices shall be connected to addressable loops capable of accepting up to 250 devices.

6.1.17 The CIE shall have a minimum capacity for operating one fully loaded addressable loop. This shall be extendable up to a maximum capacity of 8 addressable loops.

6.1.18 Addressable panels shall be capable of displaying a minimum of 16 zones up to 240 zones for the larger systems. The section of wiring corresponding to each zone circuit shall be protected from faults in other sections by line isolator device. The operation of the line isolator shall be clearly indicated by a LED on the device.

6.1.19 The CIE shall have provision for the connection of external power supplies, either local to the CIE or distributed throughout the system, to supply power in excess of that stated.

6.1.20 The CIE shall have provision to drive and monitor up to 7 repeater panels providing a repeat of the indications on the CIE display and also incorporating the full set of system manual user controls.

6.1.21 The CIE shall have provision to house the a.c. mains power supply and batteries required to power systems of up to 80 zones. Zonal indication shall be provided by the use of light emitting diodes.

6.1.22 It shall be possible to connect a computer to the CIE to display the information that would otherwise appear on the printer.

6.1.23 The CIE shall be capable of interfacing with third party equipment *via* a MODBUS interface.

6.2 Functions (Monitoring)

6.2.1 The CIE shall monitor the status of all devices on the addressable loops for fire, short-circuit fault, open-circuit fault, incorrect addressing, unauthorized device removal or exchange, pre-alarm condition, when selected, and contaminated detector condition.

6.2.2 The CIE shall monitor the status of all internal connection and interfaces, including charger, battery and remote signaling functions.

6.2.3 The CIE shall provide the following discrete visual indications:

- a) Common fire, fault, disable, and test;
- b) Power on, mains fault, system fault and day mode;
- c) Sounders activated, sounder fault, sounder disabled;
- d) Signaling activated, signaling fault, signaling disabled; and
- e) Protection activated, protection fault, protection disabled.

6.2.4 The CIE shall provide a set of push button controls to enable an authorized operator to perform the following:

- a) evacuate;
- b) silence;
- c) resound;
- d) day/night setting; and
- e) delay investigation.

6.2.5 The CIE shall provide a facility to manually check all the discrete LED indicators and the LCD display.

6.2.6 The CIE shall provide facilities to drive visual indication LED mimic displays for each of the following zonal status, that is, alarm, fault and isolated.

6.2.7 The CIE shall interrogate each addressable device at least once every 5 s.

6.2.8 The response time of the CIE to two-state addressable detectors and conventional detectors shall not exceed 10 s.

6.2.9 The CIE shall have a special scanning sequence so that designated manual call points provide alarm indication and warning within 3 s of operation.

6.2.10 The CIE shall have a facility to automatically adjust the sensitivity of addressable detectors to a higher level for periods of time when the building is unoccupied.

6.2.11 The CIE shall have the ability to automatically adjust the alarm and pre-alarm threshold levels to compensate for changes in detector sensitivity due to contamination over a period of time.

6.2.12 The CIE shall have, as standard, the ability to provide automatic warning that a detector has reached a level of contamination which requires that it be replaced or serviced.

6.3 Functions (Output)

6.3.1 The CIE shall provide the necessary outputs to separately operate two monitored circuits of common system sounders. Each output shall be capable of driving a sounder load of up to 500 mA.

6.3.2 The CIE shall be able to monitor and control the integrity of zonal sounder circuits, *via* a suitable addressable module.

6.3.3 The CIE shall be capable of providing a two-stage alarm sounder facility that can be programmed, either on a zonal basis or common system basis.

6.3.4 The CIE shall have the facility to change, on a per sounder-zone basis, the sound output signal dependent upon whether the source of alarm is an automatic detector, manual call point, others like an evacuation command, and also non-fire events like testing.

6.3.5 The CIE shall provide an interface to drive a public address system. The signal from the fire system to the PA/VA system shall be dual path such that, in the event of a failure of the primary signal the public address system defaults to a full evacuation of the protected premises.

6.4 Functions (Supervision and Reporting)

6.4.1 The CIE shall monitor all critical system components and interconnections (internal and external). In the event of a failure occurring, which prevents correct operation of the alarm functions, a fault indicator will light and a message shall be given on the alphanumeric display within 100 s of occurrence.

6.4.2 The following faults shall be reported at the CIE:

- a) Addressable device failure,
- b) Loop short circuit,
- c) Loop open circuit,
- d) Sounder wiring open circuit,
- e) Sounder wiring short circuit,
- f) Unconfigured and incorrectly configured devices,
- g) Device not responding,
- h) Detector power up fault monitoring,
- j) Detector condition monitoring warning,
- k) Auto self-test of each detector element,
- m) Conventional call point wiring open circuit,
- n) Conventional call point wiring short circuit,
- p) Conventional detector circuit wiring fault,
- q) Repeater/repeater LCD,
- r) Remote printer failure,
- s) PSU fault,
- t) Charger fault,
- u) Battery fault,
- v) Battery critical,
- w) Mains failure,
- y) Auxiliary PSU failure,
- z) Relay output inoperative, and
- aa) Signaling fault.

6.4.3 To help rapid fault finding and repair, the CIE can also provide text messages to indicate the precise location of where a fault has occurred in the system.

6.5 Management of Fire Alarm Status

6.5.1 The CIE shall incorporate the following facilities for effective system verification for its health:

- a) Isolate/de-isolate a particular addressable point,
- b) Isolate/de-isolate a particular detector zone,

- c) Isolate/de-isolate a particular sounder zone,
- d) Walk-test of a selected zone to verify detectors and call points,
- e) View the number of alarms since power up,
- f) View the number of software initializations since power up,
- g) View common alarm status,
- h) view common fault status,
- j) View common disabled status,
- k) View zonal alarm status,
- m) View zonal fault status,
- n) View zonal isolated status,
- p) View point address status,
- q) View/print full event log,
- r) View/print filtered event log,
- s) View/print points isolated, and
- t) Print a list of dirty detectors and print point status.

6.5.2 The CIE shall have an event log capable of storing up to the last 3 000 events that have occurred. It shall be possible to view the content of the log *via* the alphanumeric display. Events shall be displayed in chronological order in any of the following three options namely, newest events first; oldest event first; or highest priority event first.

6.5.3 The CIE shall be capable, *via* a suitable timer unit, of isolating a group of selected detectors in areas of the building where maintenance work is carried out. The detectors shall be automatically re-instated after a pre-determined time.

6.5.4 It shall be possible to provide short circuit wiring fault isolation to every detector on the loop.

6.6 Other ancillary equipment like line modules for detector interface, relay interface, addressable contact monitoring, input/output, sounder driver, line isolator, power supply, loop powered sounder base, sounder beacon, sounder module, operations like doors, fire pumps, HVAC, etc, shall be available for direct connection to the system addressable loops.

7 NETWORKED FIRE ALARM SYSTEMS

7.1 The functions of the CIE are not centralized in one location or panel, but distributed amongst a number of sub-panels located remotely from each other. These panels are then interconnected by a network which usually serves as a data highway. Some sub-panels may simply act as 'data gathering' panels and provide no indications. Others may be fully functional, control and indicating panels, configured so as to 'standalone' and continue to operate normally in the event of a failure of the communication links between sub-panels.

7.2 Networked system is usually installed in the following circumstances:

- a) Where the fire alarm system is large and beyond the capacity of single CIE; and
- b) Where there is a need for centralized monitoring and/or control of a number of fire alarm systems in different buildings in the same vicinity (for example, on the same site).

7.3 The effect of the communication link and the implications for fire alarm operation will depend on the configuration of the networking system the type of network and whether or not the network forms part of the critical signal path.

7.4 Ring or loop network are more resilient to communities failures than radial type network, peer to peer network with a central processor controlling panel to panel communications. All equipment used in and for a network shall be listed for the intended purpose.

7.5 All sub-panels or data gathering panels shall have the ability to function in a degraded standalone mode when communications are lost from the primary control unit. The activation of initiating devices shall cause the appropriate notification appliances to activate even when data communications is lost from the primary control unit.

8 POWER SUPPLY

8.1 General

The following general requirements of power supply system needs to be taken care:

- a) Power supply for the fire alarm system will normally be derived from the low voltage mains, the supply needs to be reliable and capable for supplying the largest load that can be placed on it under normal, fire and fault conditions.
- b) Design of the main supply to the system needs to be such that it shall not be affected by faults on other circuits or equipment, or by isolation of supplies in the building for maintenance or economy in consumption of electricity.
- c) Main supply shall need to be backed up by a standby supply that is able to support the system while the main supply is restored or fault in the mains supply is corrected. The standby supply also needs to be reliable, and transfer between the two supplies shall not affect the operation of the system.
- d) Failure of the main supply may occur when the premises are unoccupied, the system might be inoperative on reoccupation. It is important that the presence of a power supply to the system is indicated by a visual indicator at the indicating equipment to enable total power failure to be identified by the personnel.

- e) There will be a need to set some practical limit on the duration of standby batteries. However, when the premises are not occupied for longer durations, the limit recommended in this standard could be insufficient to cater for the longest periods for which premises might be unattended. The user will need to consider this aspect and arrange frequent check on the batteries or consider the need for standby batteries with a longer duration.
- f) If the premises are provided with emergency supply through a diesel generator or a captive power plant and if the process in the risk is continuous, then the capacity of the standby batteries may be reduced provided the circuits served by the generator include that of the alarm system.
- g) In some complex buildings, such as shopping centres, additional indicating equipment, such as colour graphics terminals, not essentials for compliance with this standard, may be provided to assist the user in the monitoring and control of fire incidents. Stand-by supply shall take care of this equipment also.

NOTE — Detailed requirements for the above are listed in various clauses below.

8.2 Requirements

The requirements shall be as given below.

- a) The system shall derive its power from either, the mains electricity supply single phase (normal supply), or the standby power supply that shall be immediately available in the event of failure of normal supply and shall be automatically connected (automatic switch-over) so as to maintain the equipment in ready condition of taking the maximum load. The standby shall be derived mostly from exclusive secondary batteries where captive power generation (like automatically started generation, continuously running generation) is readily and certainly available, such as in process plants, industrial complexes and other occupancies, a standby can be derived from there.
- b) The CIE shall be connected to the mains *via* a switch-fuse or moulded case circuit breaker (MCCB) reserved solely for the purpose, its cover being painted red and labeled 'FIRE ALARM', 'DO NOT SWITCH OFF'. Switch-fuse shall be contained in a securely closed box and the condition of 'main-on' shall be indicated by a new lamp. The voltage and ampere ratings shall be compatible with the requirements of various parts of the system and power capacity of the power supplies shall meet the maximum load likely to be placed on the system.

Where the user requires isolating the building during closed hours, a separate supply shall be provided for the fire alarm system that shall not normally be isolating during closed hours.

- c) The minimum capacity of the normal mains supply shall be calculated so as to meet the total power consumption of the entire system in quiescent condition plus that of all the sounders and 25 percent zones in alarm condition.
- d) Main connection to the system shall be arranged such that the mains supply to the system (which is through exclusive switch-fuse) is not interrupted as a result of switching off mains power to premises/other services. Provisions made for normal and standby power supply shall be such that the switch-over from one supply to another is automatic and each is capable of supplying the largest load to be placed on them under normal, fire and fault conditions. Further, the power supply for the fire alarm system shall be totally dedicated and shall not be connected to other loads.
- e) The standby power supply shall be capable of maintaining the system in normal operation for a period of not less than 48 h after the failure of normal mains supply after which sufficient capacity would remain to provide full load operation for at least 30 min. The full load would be defined as that caused by the operation of all the alarm sounders operating simultaneously, operation of a detector in at least 25 percent of zones (with a minimum of two zones) and the operation of the fault indicator. The operation of trigger devices in further zones shall not result in cancellation of fire alarms existing at that time.

NOTE — Where failure of normal mains supply is not likely to be made good within 24 h due to long unattended/unoccupied periods, the system inspection frequency needs to be arranged at intervals such that in the event of normal mains supply failure, at least 24 h standby capacity remains at the time of next inspection.

- f) Standby power supply derived from exclusive back-up batteries shall have provision of automatic charging and automatic load switch-over whenever normal mains supply fails. It shall be ensured that charging conditions are matched to the system. The rate of battery charging shall be such that, having discharged to its final voltage, the battery can comply with the recommendations of 6.5 after a charging period of 24 h.
- g) External batteries shall be properly mounted. The best practice shall be to mount them on a metal stand at a well-ventilated location.
- h) Every isolator, switch and protective device that is capable of disconnecting the mains supply to the fire alarm system, shall be situated in a position inaccessible to antiauthority persons or be protected against unauthorized operations by persons without a special tool.
- j) Voltage of the batteries shall be monitored and low voltage indicated on CIE.

- k) Capacity of the battery shall be as per calculations shown in Annex B.
- m) Battery charger shall be designed for automatic charging. A battery discharged to its final voltage shall be provided with charging facility which provides at least 80 percent of the rated capacity within 24 h.
- n) Where distributed power supplies for fire alarm system to power sounders, beam detectors, etc, are installed, it shall be mandatory that the entire system be powered from the CIE panel power/back-up and the same shall be monitored.

9 CABLES AND THEIR INSTALLATIONS AND CIRCUITS

Proper selection of cables their installation and laying circuits are essential for the CIE to be effective.

9.1 General

The following general requirements shall be adhered in the installation of cables and circuits:

- a) The components of most fire alarm systems are connected by cables and wiring and hence, cables are the most important link between fire detection devices and the control centre. It is essential that the cables used for interconnection of devices and the control centre remain operational and maintain circuit integrity for adequate duration with inherent capability to resist direct exposure to fire.
- b) It is essential that all interconnections operate correctly at the time of a fire. This is particularly important in the case of cables that link CIE to manual call points, automatic fire detectors and fire alarm devices, and that transmit signals to an alarm receiving centre.
- c) It is not normally possible to predict, with any accuracy, those areas of a building in which fire can or cannot occur. At the design stage, the exact route that cables will follow may also be unknown. Therefore, to ensure that cables used remain operational for an adequate duration, cables, with an inherent ability to resist attack by fire, need to be used throughout.
- d) The integrity of the mains supply to the system is also regarded as essential, even though the system has a standby supply. Accordingly, mains supply circuits need to be adequately protected against the effects of fire.
- e) The probability of disablement of any part of the fire alarm system as a result of mechanical damage to cables can be reduced by the use of sufficiently robust cables, careful selection of cable routes and by the provision of protection against mechanical damage in areas where cables are susceptible to mechanical damage. Monitoring of circuits does

not ensure that cable faults will not occur, but is essential to minimize the time between occurrence and identification (and hence repair) of the fault. Monitoring of circuits and protection of cables against damage are, therefore, complementary precautions, rather than alternatives.

- f) It is the responsibility of the designer to ensure that the electrical characteristics of the cables, including current carrying capacity and voltage drop are suitable for the system. The choice of cable and routes selected shall need to consider the need to avoid electromagnetic interference from other cables and source of electromagnetic radiation, particularly in the case of the system in which cables are used to be combative with the characteristics of the data transmission, for example, speed and waveform and remain so far, an adequate length of time during the relevant exposure to fire for category of cable.
- g) The circuit of fire alarm systems shall need to be segregated from the cable of the other circuit to minimize any potential for other circuit to cause malfunction of the fire alarm system arising from,
 - 1) breakdown of cable insulation of other circuit and/or fire alarm circuit;
 - 2) a fire caused by a fault on another circuit;
 - 3) electromagnetic interference to any fire alarm circuit as a result of the proximity of another circuit; and
 - 4) damage resulting from the need for other circuit to be installed in, or removed from, ducts or trucking containing a fire alarm circuit.
- h) In order to facilitate identification of fire alarm circuit, cable shall preferably be red in colour, unless another form of colour coding is appropriate. By this means, the possible need for appropriate segregation can be identified, and there will be less likelihood of inadvertent manual interference with the circuit of fire alarm systems.

9.2 Cables

9.2.1 The electrical characteristics of all cables, such as voltage drop, current carrying capacity, impedance, and where appropriate, ability to transmit data, shall be suitable for the system.

The cable specification for fire alarm system is as follows:

- a) Armoured or unarmoured fire retardant low smoke (FRLS) cables of minimum $2 \times 1.5 \text{ mm}^2$ annealed tinned copper (ATC) cables for conventional fire alarm and multi-strand, twisted pair shielded cables for addressable fire alarm system;
- b) PVC insulated copper conductor cables conforming to IS 694 having minimum 1.5 mm^2

cross-sectional areas, if stranded at least 0.5 mm^2 cross-sections shall be used;

- c) Rubber insulated braided cables conforming to IS 9968 (Part 1);
- d) Armoured PVC/rubber insulated cables conforming to IS 1554 (Part 1); and
- e) Mineral insulated (MI) cables with overall LSF (low smoke and fumes).

NOTE — It is strongly recommended to use cables mentioned under item 'e' above for certain specific occupancies like oil and hydrocarbon industries (high hazard, high fire potential), airports (high hazard and also large public presence), jetties (high hazard, high fire potential), power plants (critical for use), metro railways (underground and large public presence, life safety), and where huge public gathering is anticipated like shopping malls, multiplex and large assembly halls (life safety), etc, where either the fire load is high or the intolerance of downtime for the occupancy or life safety is foremost.

9.2.2 The cables used shall be exclusively for fire detection system. The multi-core cables shall not be shared for other low voltage or high voltage circuits.

9.2.3 Cables/wiring shall be laid down in metallic/rigid PVC conduits. PVC conduits shall be used only in concealed spaces.

9.2.4 Cables connected to detectors shall be given 'S' loop on both the sides of the detectors which shall be properly clamped to the ceiling. Loop shall also be left where cables connect sounders, panels, dampers, etc. Appropriate glands shall be provided where the cable enters the junction box.

9.2.5 All the cables and wires shall be tagged for proper identification. Wires shall be identified by ferrules at junction and cables by colour bands at every 3 m distance.

9.2.6 When connecting different buildings, etc overhead lines for fire alarm system shall not be used. They shall be laid underground according to IS 1255.

9.3 Conduit Wiring

The following requirements shall receive attention:

- a) The conduits shall not be choked with cables. There shall be sufficient space inside the conduit even after the cable is pulled. The minimum size of the conduit shall be 25 mm.
- b) S-runs of conduits which shall be spaced at not more than 4.25 m between draw boxes, shall not deflect from the straight by an angle more than 15° . B-runs of conduits shall not deflect from the straight by more than 15° . Conduits shall be kept at a minimum of 100 mm from the pipes of other non-electrical services.
- c) Wiring for short extensions to outlets in hung ceiling or to vibrating equipment, motors, etc,

- shall be installed in flexible conduits. No flexible extension shall exceed 1.2 m in length.
- d) Cables and conduits running on surfaces shall be supported on galvanized steel 6 mm thick saddles and clamps which in turn are properly screwed to the wall or ceiling. Saddles shall be at intervals of not more than 500 mm. Fixing screws shall be with round or cheese head and of cadmium plated brass.
 - e) Exposed conduits shall neatly run parallel or at right angles to the walls of the building. Unseemly conduit bends and offsets shall be avoided by using fabricated galvanized steel junction/pull through boxes for better appearances.
 - f) No cross-over of conduits shall be allowed unless it is necessary and entire conduit installation shall be clean and neat in appearance. Conduits embedded into the walls shall be fixed by means of staples at not more than 500 mm intervals. Chases in the walls shall be neatly made and refilled after laying the conduit.
 - g) Conduits buried in concrete structure shall be put in position and securely fastened to the reinforcement before the concrete is poured. Proper care shall be taken to ensure that the conduits are neither dislocated nor choked at the time of pouring the concrete.
 - h) Suitable galvanized steel fish wires of not less than 0.63 mm diameter shall be drawn in all conduits before they are embedded. Where conduit passes through expansion joints in the building, adequate expansion fittings shall be used to take care of any relative movement.
 - j) Inspection boxes shall be provided for periodical inspection to facilitate withdrawal and removal of wires. Such inspection boxes shall be flush with the wall or ceiling in the case of concealed conduits. Inspection boxes shall be spaced at not more than 12 m apart or two 90° solid bends or equal.
 - k) All junction and pull boxes shall be covered by 6 mm clear plate truly cut and fixed with cadmium plated brass screws. These junction boxes shall form part of point wiring or conduit wiring as the case may be including the cost of removing the cover for painting and refixing.
 - m) Conduits shall be free from sharp edges and burs and the threading free from grease or oil. The entire system of conduits must be completely installed and rendered electrically continuous before the conductors are pulled in.
 - n) Conduits shall terminate in junction boxes of not less than 32 mm deep and the termination shall be rigid with check nuts and a smooth bushing. No wires shall be exposed in any part of the installation.
 - p) Conduits and cables shall be laid by skilled and experienced workmen. Great care shall be taken while laying cables to avoid kinks. At all changes in directions (vertical and horizontal planes) the cables shall be bent smooth with a radius as recommended by the manufacturer(s).
 - q) No joints shall be allowed between two points. The sleeve at joints shall be shaved off like a pencil and shall not be cut square to avoid cutting of conductors.

10 CONTROL CENTRE (FOR HOUSING CIE)

- a) In high rise buildings and special buildings, a control centre of an area of 15 m² to 20 m² shall be provided where the CIE, power supply units and other fire protection ancillary panels could be installed. This shall preferably be on ground floor (floor one) and manned 24 h.
- b) The control centre room shall have attached WC, bath, drinking water facilities and appropriate tables, chairs, record racks, etc.
- c) The control centre room shall have emergency lighting system.
- d) The control centre room shall have intercom and direct telephone facilities. Where possible, a direct hotline or any other means of communication to local fire brigade shall be provided.
- e) The control centre room shall have mimic panel of the premises protected and details of all the fire protection systems. Fire orders shall be prominently displayed.
- f) Control centre in air-conditioned premises shall be segregated from the rest of the buildings by fire walls, and provided with an independent air conditioning system. If ducts are common, the entry/exit points of ducts through the walls shall be provided with automatic damper units. Status of these dampers shall also be displayed in the mimic panel.

11 CONTROL AND INDICATING EQUIPMENT (COMPONENTS)

11.1 Sector/Zone Panels and CIE

- a) The sector/zone panel shall be installed on individual sector/zone of the building and shall conform to the requirements given in Annex C.
- b) The CIE and other control panel shall be wall mounting/floor standing type and shall be made of mild steel sheet conforming to IS 513 (Parts 1 and 2). The minimum thickness of sheet shall be 1.6 mm. The colour shall be fire red (shade no. 536 of IS 5).
- c) Electronic/electric circuit shall have relay conforming to IS 5051 (Parts 1 to 3).

- d) Each sector/zone indicator, indicating fire shall consist of two LED/filament bulbs conforming to relevant Indian Standards connected in parallel. In case of fault indicators, only one LED/filament bulb shall be used — open and short circuit separately. Fire warning indicator shall be clearly labelled and coloured red while fault warning indicator shall be clearly labeled and coloured amber.
 - e) The sector panels shall have the power capacity to be connected to all the zones in the sector. In addition, it shall have facility for connections to external sounders.
 - f) If required, the panel shall have additional capacity to operate auxiliary equipment like fire dampers, fire doors, ventilation and/or pressurizing fans, emergency light, smoke exhausters, etc. Failure of power at the local sector panel shall be indicated in the main control room.
- c) Sounding of alarms can be so arranged that any alarm can operate all the sounders throughout the premises. This grouping is particularly suitable for smaller premises.
 - d) Sounding of alarms can be so arranged that the alarms sound initially in the sector of fire origin or in this zone and on its adjoining areas, or in this zone and in specially selected areas of high flammability or difficult egress.

11.3 Silencing

The operation of silencing switch either for general fire alarm sounders or for signal controlling internal audio alarm of CIE shall cause an audible signal to be given in or near the CIE. This audible signal which may be the same as that for fault warning, is intended to act as a reminder that the silencing switch has been operated and shall give a distinctive sound different from that of any other alarm sounder (external or internal to CIE).

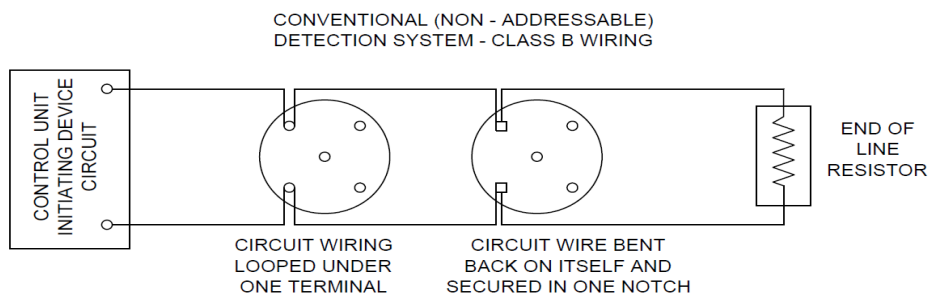
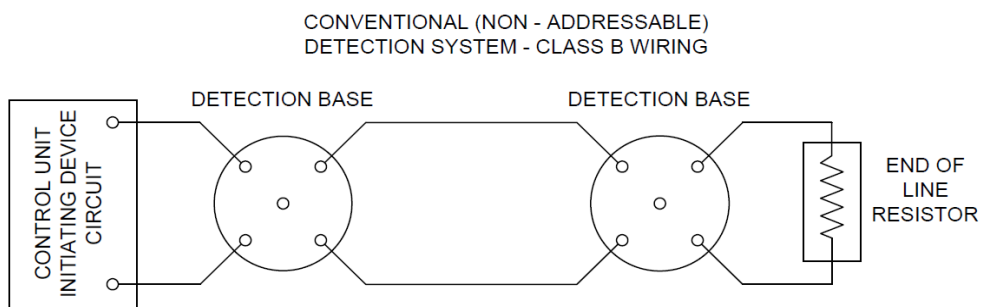
NOTE — The requirement given here are not necessary in systems where automatic re-set is provided.

11.2 Fire Alarm/External Fire Alarm Sounders

- a) A number of external fire alarm sounders are generally required for protecting premises. The number and distribution of these alarms in the premises shall be such that the sound level/audibility requirements are met with a view to alert the occupants and initiate firefighting actions with the least delay.
- b) The grouping of external fire alarm sounders can be done in either of the following way. The grouping scheme shall be reflected in fire instructions issued for the use of the occupants.

11.4 Visual Alarm Signals

In general, visual signals shall only be used to supplement audible alarms. A defect in visual alarm shall not cause a defect in audible alarm or *vice versa*. Only in special cases where audible alarm is ineffective, such as even the occupants are deaf, immobile, etc, visual alarms can be used *in lieu* of external alarm sounders.



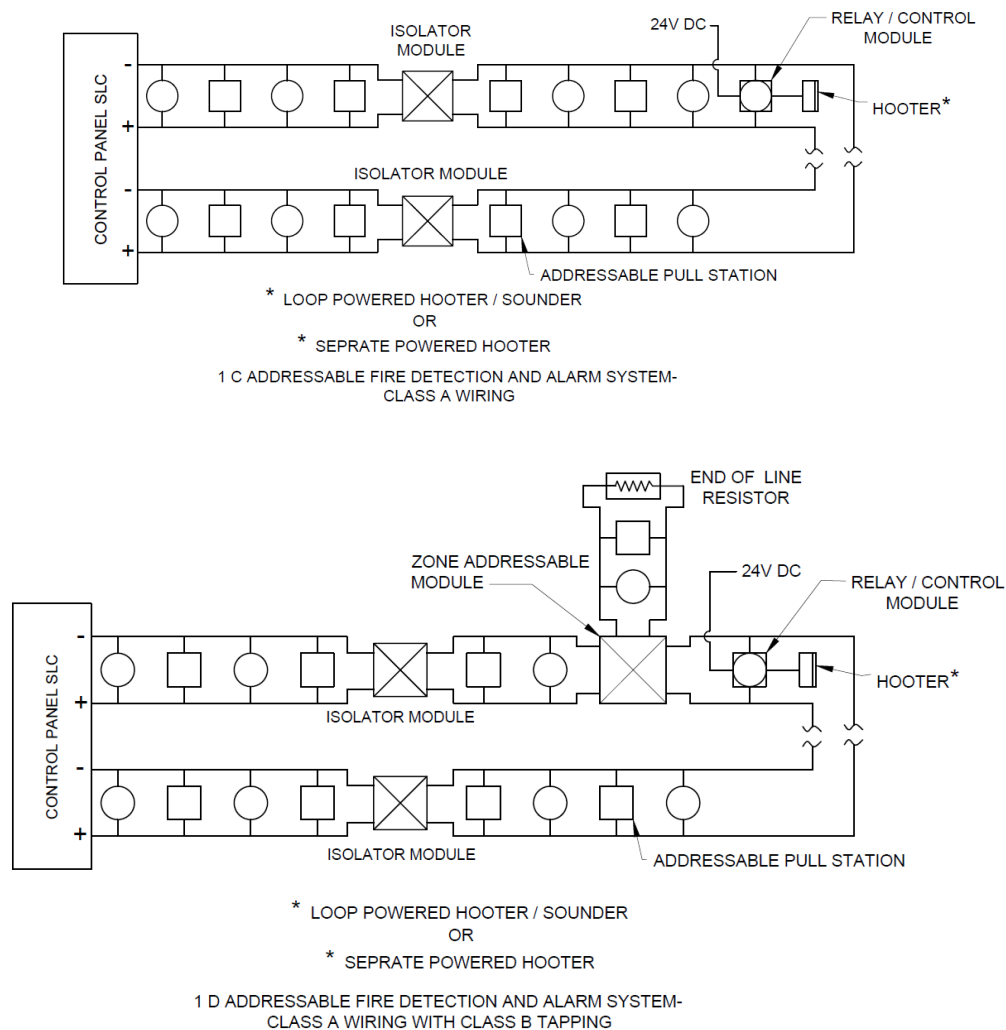


FIG.1 WIRING DETAILS FOR DETECTION AND ALARM SYSTEM

11.5 Stages of General Fire Alarms

General fire alarm system though external sounders can be provided in either of the following ways:

- a) *Single Stage Continuous Alarm* — In this scheme, a continuous alarm (evacuation alarm or signal) sounds in the sector/zone of fire and also on the CIE with a provision on CIE to sound continuous general fire alarm throughout the protected premises. This is normally done, particularly in smaller premises, sparsely populated premises or storage premises.
- b) *Two-Stage General Alarms* — In this scheme, two-stage alarm is provided in which a continuous evacuation alarm is immediately given in sector/zone of fire or in a restricted area, together with intermittent 'alert' signal in other parts
- c) The 'evacuation' signal shall be continuous and intermittent 'alert' signal shall have 'ON' and 'OFF' periods of 1.0 ± 0.5 s each.
- d) In large installations and extensive high-rise buildings, two-stage alarm scheme may be more desirable to evacuate first the sector/zone where fire exists, other high-risk areas or restricted areas and simultaneously 'alert' other areas.

11.6 Special System

Here the alarm sounds only in the control centre of the CIE and may also have public address facility to alert personnel who are mobile within or in the vicinity of the building. Depending on the choice of the system, CIE shall have necessary controls. Where two stage alarm is chosen, zonal/sectors panels and CIE are needed and in case of single stage, zonal/sector panels are not needed. The system may also adopt any of the cabling scheme, that is connecting the zones/sectors directly to the CIE or through zone/sector control panels. The audible and visual alarm state shall be maintained by the sector/zonal control panels and control panel of CIE without a continued signal from fire detector. The sound characteristics of the alarm shall be similar throughout the protected premises.

11.7 Fire Alarm Intimation

The operation of fire detector/manual call point shall initiate transmission of signal(s) resulting in,

- a) an audible signal on the CIE (internal audio alarm of CIE);
- b) a visual signal in the CIE;
- c) at least one external alarm sounder;
- d) a visible indication for each sector/zone in which a detector/MCP is in operations; and
- e) audible signal (alert) on sector/zonal panel concerned where sector/zonal panels have been provided.

In case of two stage alarm systems, if the alarm in the first instance is not acknowledged on CIE, preferably within 60 s, a general evacuate alarm shall sound on all the floors.

11.8 Silencing of Fire Alarm

The audible alarm(s) as specified in 11.3 shall continue to operate until silenced manually. The alarm shall not be silenced automatically. The operation of the silencing switch shall automatically result in an audible/visual signal being given at CIE until the fire alarm is reset.

NOTE — Provisions in this clause are not necessary in case of automatic reset system.

The equipment shall be so designed that following the silencing of alarm sounders, in the event of subsequent operation of detector and MCP in any other zone, further fire alarm as specified in 9.3 shall be given.

Any fault signal which the CIE may be giving shall not prevent a fire alarm being given, if the detector actuates at the same time or subsequently from the other zone.

11.9 Fault Signals

An immediate fault warning shall be given by visible indicator (amber) on the sector/zone control panel (where provided), and an audible alarm and visible indicator (amber) on the CIE in the control centre. The audible alarm shall be distinct from the fire alarm.

- a) The zonal arrangement in the panel shall be modular and mere replacement of fault module/relay plug in components shall put the alarm system back in operation.
- b) Fault warning shall be given at CIE in the event of the following occurrences:
 - 1) Failure or disconnection of normal power supply.
 - 2) Failure or disconnection of standby power supply.
 - 3) Failure or disconnection of battery charging equipment.
 - 4) Short-circuit or disconnection of the leads to trigger devices unless fault conditions reproduces the effect of operation of a triggered device.
 - 5) Removal of any triggered device of the plug-in type or disconnection from its transmitter or power supply.
 - 6) Short-circuit or disconnection of any of the leads to alarm sounders external to the CIE but if the alarm sounders are connected by a ring circuit, disconnection need not be immediately indicated but shall be capable of being detected by the routine test procedure.
 - 7) Rupture or disconnection of any fuse on the operation of any protective devices that would prevent a fire alarm being given.
 - 8) Failure of a scanning device to interrogate the detector or zones at the correct time intervals or failure of any monitoring or interrogating system within the control equipment, such as to prevent an alarm being given.
 - 9) A facility may also be provided for sending fault signal to remote centre.
- c) It is desirable to have distinct earth fault indication of the zone wiring.
- d) A facility shall be provided for deliberate isolation of zones/sectors. This facility shall be inside the panel, not easily accessible to people. Whenever isolation is used, this shall be given visible indication.
- e) Circuits and mechanical design of the panel shall be such that the operation of one indicator does not prevent the proper and separate operation of the other indicators and the alarm is not inhibited by any defect/failure in the indicator.
- f) Each fire/fault indicator shall be clearly labeled with the zone address on a metal label from which the call originates.
- g) 'System on' and 'Standby on' indicators shall be provided. Where system test key/switch is lockable, indicator shall be provided.

- h) Test facilities, shall be provided to test alarm circuit sounder, indicator, etc.
- j) The following shall be provided:
 - 1) Acknowledge button;
 - 2) Where required, alarm cancel indicator;
 - 3) Isolation/reset facility; and
 - 4) Related fuses/protective devices.
- k) Sector/zonal control panel shall be provided with voltages appropriate to the rating of the interconnected detectors. The voltage drop in the cable risers shall be considered.

11.10 Fire Alarm (Sounder)

Depending on the floor area and its layout, external audible fire alarm sounders shall be provided to give the required sound level with a minimum of a pair of sounders in parallel. The number of fire sounders shall be sufficient to produce the sound levels as specified in IS 15575 (Part 1) (*see* Annex D).

The circuit feeding power from control panel to these fire alarm devices shall be a ring circuit. If a ring circuit is not provided, design provision to give a fault signal on CIE in the event of short circuit or disconnection shall be made.

11.11 Accessories and Controls

The following shall be adhered:

- a) CIE shall be installed in the control room on ground floor, or in the case of industrial premises, separate process control rooms are provided, and shall be of the wall mounting/desk/floor standing type.
- b) The manual controls for switching off/on, main/stand by power shall not be accessible to outsiders.
- c) All manual controls shall be clearly labeled to indicate the mode of operation and their functions (metal label to be used).
- d) The CIE shall have electronic/electrical relays conforming to relevant Indian Standards and shall have the following facilities:
 - 1) A pair of red LED/bulb to indicate origin of fire and an amber LED/bulb to indicate the origin of fault;
 - 2) A sounder with distinct audible sounds for fire and fault alarm;
 - 3) Audible signal acknowledge/silence button and lamp/LED to indicate its operation, whenever necessary;
 - 4) Voltmeter and ammeter shall be provided on main d.c. power circuit;
 - 5) 'SYSTEMS ON', 'STANDBY ON' indicators, test key/button operation indicator and facility to isolate zonal/sector/main control panel from the rest of the system;

- 6) Where sector panel is isolated, its signal shall come on the main control panel and where zonal panel is isolated the signal shall come on the sector panel;
- 7) Failure of any indicator circuit shall not prevent the fire alarm from sounding, nor acknowledgement/silencing of the alarm from one zone shall prevent another alarm coming from the other zone on the same sector;
- 8) Switch to actuate alarms from CIE to one or more sectors/zones;
- 9) Test facility to check fire alarm/fault circuit, indicators; and
- 10) Facility for indicators to acknowledge the operation of the ancillary system (one colour code shall be associated with one ancillary service and one or more indicator per zone).

NOTE — In high rise/special building like educational, institutional, assembly, business, mercantile and hotels, a handset/two-way speaker with relevant indication switches shall be provided for voice communication with different floors when the circuit is actuated by inserting the handset in manual call point sockets (which is not a part of the fire alarm system).

- e) All zonal/sector control panels and CIE shall be provided with proper earthing.

12 INSTRUCTION MANUAL

The record drawings and operating instructions shall be supplied by the installers on completion of the installation. Drawings shall clearly indicate, for maintenance and record purposes, the position of various items of the equipment, junction boxes, sizes and routes of all cables and wires and such other relevant details. If so desired by the user, circuit diagrams of the fire alarm system and its components shall also be supplied. These drawings and operating instructions shall be kept up-to-date and be available for convenient reference and shall be located in the control room.

The installer shall supply the user with a log book. The log book shall be maintained for recording details, including causes of all the alarms (genuine, practice, test or false), faults, service tests and routine inspections, servicing/repairs, etc as and when done. Periods of disconnection/in-operation shall also be shown.

13 INSPECTION, TESTING AND MAINTENANCE

13.1 General

Even a well-designed and properly installed automatic fire alarm system will not be able to render reliable and trouble-free service unless high standard of maintenance and supervision are ensured during the entire service period of the system. Regular inspections and scheduled preventive maintenance are critical and shall include all the components of the system.

13.2 Initial Installation Inspection Tests

13.2.1 After installation, a visual inspection of all the detectors shall be made to make sure that they are properly sited. Each detector shall be inspected to ensure that it is properly mounted and connected.

13.2.2 Restorable heat detectors and restorable elements of combination detectors shall be tested by a heat source, such as a hair dryer, or a shielded heat lamp until it responds, making sure that the sensing element is not damaged. After each heat test, the detector shall be reset. Precautions shall be taken to avoid damage of the non-restorable fixed temperature element of a combination rate of rise/fixed temperature detector.

13.2.3 Non-resettable fixed temperature heat detectors which are not to be heat-tested shall be tested mechanically or electrically for fire alarm function.

13.2.4 Heat detectors with replaceable fusible alloy element shall be tested first by removing the element to see whether contact operate properly and then re-inserting them in proper position.

13.2.5 In periodic testing, heat detectors shall be visually examined for damage or other conditions (such as heavy coats of paints, etc) likely to interface with the correct operation.

13.2.6 Each smoke detector shall be tested to initiate an alarm at its installed location with smoke or other approved aerosol which demonstrates that the smoke can enter the chamber and initiate an alarm.

13.2.7 In order to ensure that each smoke detector is within its sensitivity range, it shall be tested using any of the following:

- a) Calibrated test method,
- b) Manufacturer's/supplier's approved calibrated sensitivity test instrument,
- c) Approved control equipment arranged for the purpose, and
- d) Other approved calibrated sensitivity test method.

13.2.7.1 Detectors found to have sensitivity outside the approved range shall be replaced.

NOTE — Detector sensitivity cannot be tested or measured using any spray/smoke producing device that administers an unmeasured concentration of aerosol/smoke into the detector.

13.2.8 Other types of detectors like flame detectors, spark/ember detectors, aspirating type smoke detectors, etc shall be tested for sensitivity in accordance with the recommendations of the manufacturers and/or the standards according to which they are made.

13.3 Servicing/Periodical Maintenance

13.3.1 To ensure that regular and reliable servicing/maintenance of the systems and its

components is carried out, any of the following methods shall be adopted:

- a) Through an agreement/contract with the competent contractor who shall attend to the maintenance/repair, when necessary, promptly.
- b) Where no such service contract can be entered into for any reason, atleast one qualified employee of the user with suitable experience of electrical equipment shall undergo special training to deal with all aspects of basic servicing and maintenance, including routine sensitivity tests/checks of the detectors, as and when required.

13.3.2 For institutional occupancies, such as hospitals, hotels, old people's homes, etc the provision shall include a requirement that an engineer shall be on call at all times and that request over the telephone for emergency service shall be executed promptly, within 24 h. Serving arrangement shall be made immediately on completion of the installation whether the premises are occupied or not. If the premises are not occupied, special precautions shall be taken, if necessary, to protect the system against damage by dampness or other causes.

13.4 Maintenance Schedule

13.4.1 It is the responsibility of the user of the equipment to ensure that proper instructions are obtained from the manufacturer/supplier or installer regarding the routine attention and test procedures.

13.4.2 The routine to be adopted in individual premises may vary with the use of the premises, equipment installed in corrosive or dirty environmental conditions will need to be checked more thoroughly and at more frequent intervals than that in clear and dry situations. Care shall be taken that all equipment are properly reinstated after testing. The occupants of the premises shall be notified of any test of the system that may result in the sounders being operated.

13.4.3 Daily Attention by User

A check shall be made every day to ascertain that the panel indicates normal operation, if not, that any fault indicated is recorded in the log book and is receiving urgent attention, and any fault warning recorded the previous day has received attention.

13.4.4 Weekly Attention by the User

The following tests shall be made every week to ensure that the system is capable of operating under alarm conditions:

- a) Once a week, at least one trigger device or end of line switch on one zone circuit shall be operated to test the ability of the CIE to receive a signal and to sound the alarm and operate other warning devices. If there is more than one zone

on a system having unmonitored wiring, each unmonitored zone shall be tested each week, but without sounding the alarm more than once. For systems having monitored wiring and up to 13 zones, each zone shall be tested in turn but if there are more than 13 zones, more than one zone may need to be tested in any week so that the interval between tests on one zone does not exceed 13 weeks. It is preferable that each time a particular zone is tested, a different trigger device is used. An entry shall be made in the log book quoting the particular trigger device that has been used to initiate the test. If the operation of the alarm sounders and/or the transmission of the alarm signal has been prevented by disconnection, then a further test shall be carried out to prove the final reinstatement to the sounders, and if permissible, the alarm transmission circuits; and

- b) A visual examination of the battery and connection shall be made to ensure that they are in good condition. Action shall be taken to remedy any defect, including low electrolyte level.

Any defect noticed shall be recorded in the log book and reported to the responsible person, and action shall be taken to correct it.

13.4.5 *Quarterly Inspection and Test by the User*

The following check-list and test sequence shall be carried out:

- a) Entries in the log book since the previous inspection shall be checked and any necessary action taken.
- b) Batteries and their connections shall be examined and tested to ensure that they are in good serviceable condition.
- c) Where applicable, secondary batteries shall be examined to ensure that the specific gravity of electrolyte in each cell is correct. Necessary remedial action shall be taken and an appropriate entry made in the log book. Care shall be taken to ensure that hydrometers, vessels, etc used in the servicing of alkaline secondary cells are not contaminated by acid and *vice-versa*. Contamination of electrolyte can ruin a cell.
- d) Primary batteries, including reserves, shall be tested to verify that they are satisfactory for a further period.
- e) The alarm function of CIE shall be checked by the operation of a trigger device in each zone as described. The operation of alarm sounders and any link to a remote manned centre shall be tested. All ancillary functions of the control panel shall also be tested where practicable. All

fault indicators and their circuits shall be checked preferable by simulation of fault conditions. The CIE shall be visually inspected for signs of moisture ingress and other deterioration.

- f) A visual inspection shall be made that structural or occupancy changes have not affected the requirements for the siting of trigger devices (manual call points, smoke detectors and heat detectors). The visual inspection shall also confirm that a clear space of at least 750 mm radius is preserved in all directions below every detector, that the detectors are preferably sited and that all manual call points remain unobstructed and conspicuous.

Any defect shall be recorded in the log book and reported to the responsible person, and action shall be taken to correct it.

13.4.6 *Annual Inspection Tests*

The following checks and test sequence shall be carried out:

- a) The instructions and test routines detailed in 13.4.5 (a) to (f).
- b) Operation of at least 20 percent of the detectors in an installation shall be checked each year and the selection shall be done in such a way that all the detectors in an installation shall have been checked once in every 5 years and if required, replaced by a new one.
- c) Each detector shall be checked for correct operation using specified test equipment and method, except non-resettable detectors. The checks to be carried out are specified in 13.2.2 to 13.2.5 in respect of heat detectors and, 13.2.6 and 13.2.7 in respect of smoke detectors.
- d) Visual inspection shall be made to confirm that all cable fittings and equipment are secure, undamaged and adequately protected.
- e) At least once in every three years at the annual inspection, the electrical installation shall be tested. Any defect shall be recorded in log book and suitable remedial action shall be taken.
- f) On completion of the annual inspection, the entry shall be made in register in respect of defects found. After the defects are rectified, the entries shall then again be made.

13.5 *General Points about Detectors*

It is essential (particularly for installations involving life hazard) to ensure specified range of sensitivity of the detectors being installed and that the correct degree of sensitivity is maintained. Users shall satisfy themselves on this point. Sensitivity range shall be

checked on equipment as already specified. It is essential to apply frequent sensitivity checks and routine tests as prescribed in the standard so that the correct sensitivity level/degree is maintained during the entire service span of the installation.

13.6 Cleaning and Maintenance

Detectors require periodic cleaning to remove dust or dirt that has accumulated. The frequency of cleaning depends upon the type of detector and local ambient conditions. In any case, the interval shall not exceed a period of 3 months. For each detector, the cleaning, checking, operating and sensitivity adjustment shall be attempted only after consulting manufacturer's instructions. These instructions shall detail methods, such as creating vacuum to remove loose dust and insects, and cleaning heavy greasy deposits, following partial disassembly or the cleaning or the washing of detectors to remove contamination, the sensitivity test requirements in accordance with the relevant clauses shall be performed.

13.7 Tests Following an Alarm or Fire

All detectors suspected of exposure to a fire condition shall be tested in accordance with the provisions contained in this standard pertaining to annual inspection tests. In addition, a visual check of the battery charger shall be carried out to ensure perfect serviceability. However, a check shall be made to the extent of damage, if any, to the cables and other components and also the operation of the systems as a whole.

13.8 System Disconnection during Testing

Care shall be taken to minimize the disruption of the normal use of the building by alarm sounding during detector testing. If detectors are removed for testing or servicing, replacement detectors shall be provided.

13.9 Spares

It may not be necessary to keep spares in premises other than covers for manual call point and fuses and other essential spares which shall be worked out based on installation.

ANNEX A

(Clause 2)

LIST OF REFERRED INDIAN STANDARDS

<i>IS No.</i>	<i>Title</i>	<i>IS No.</i>	<i>Title</i>
5 : 2007	Colours for ready mixed paints and enamels (<i>sixth revision</i>)	2175 : 1988	Specification for heat sensitive fire detectors for use in automatic fire alarm system (<i>second revision</i>)
513	Cold reduced carbon steel sheet and strip	5051	Specification for relays for electronics and telecommunication equipment:
(Part 1 : 2016)	Cold forming and drawing purpose (<i>sixth revision</i>)	Part 1 : 1982	General requirements and tests (<i>first revision</i>)
(Part 2 : 2016)	High tensile and multiphase steel (<i>sixth revision</i>)	Part 2 (Sec 1 to 3) : 1982	Reed relays
694 : 2010	Polyvinyl chloride insulated unsheathed and sheathed cables/cords with rigid and flexible conductor for rated voltages up to and including 450/750 V (<i>fourth revision</i>)	Part 3/Sec 1: 1985	Armature relays, non-sealed: Sec 1 Type RA 1
1255 : 1983	Code of practice for installation and maintenance of power cables upto and including 33 kV rating (<i>second revision</i>)	8757 : 1999	Glossary of terms associated with fire safety (<i>first revision</i>)
1554	Specification for PVC insulated (heavy duty) electric cables: Part 1 For working voltages upto and including 1100 V (<i>third revision</i>)	9968 (Part 1) : 1988	Elastomer insulated cables: Part 1 For working voltages upto and including 1100 V (<i>first revision</i>)
(Part 1) : 1988		11360 : 1985	Specification for smoke detectors for use in automatic electrical fire alarm system
		15575 (Part 1) : 2016/IEC	Electroacoustics — Sound level meters: Part 1 Specifications (<i>first revision</i>)
		61672-1 : 2013	

ANNEX B

[Clause 8.2 (k)]

METHOD OF CALCULATION OF STANDBY BATTERY
CAPACITY FOR FIRE ALARM PANEL

B-1 VALVE REGULATED LEAD ACID BATTERIES

Apply the following formula:

$$C_{\min} = 1.25 (T_1 I_1 + D I_2 / 2)$$

where,

$C_{\min}$	minimum capacity of the battery when new at the 20 h discharge rate and at 20 °C, in Ampere-hours;
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T_1	total battery standby period, in h;
I_1	total battery standby load, in Amperes;
D	de-rating factor;
I_2	total battery alarm load, in Amperes.
NOTES 1 If $C_{\min}/20 > I_2$, then take $D = 1$. If $C_{\min}/20 < I_2$, then the value of $D = 1.75$ or manufacturer's recommended value. 2 In actual practice, $C_{\min}$ is unlikely to correspond exactly to an available battery capacity and hence the next available capacity size should be used.	

B-2 OTHER TYPES OF BATTERIES

The minimum capacities should be determined in consultation with the manufacturer and should consider:

- a) standby load,
- b) alarm load,
- c) any required de-rating to consider the higher current drawn in the alarm condition, and
- d) a de-rating factor to consider battery ageing during the anticipated life of the battery.

ANNEX C

[Clause 11.1 (a)]

**PERFORMANCE TESTS/REQUIREMENTS FOR CONTROL
AND INDICATING EQUIPMENT (CIE)**

C-1 GENERAL

C-1.1 Control and indicating equipment (CIE) and sector/zonal panels shall be subjected to performance tests. For the purpose of these tests, standard production sample of equipment panel shall be taken and tested in minimum configuration arrangement. When the size is large, the tests are to be applied to damage prone electronic/electric parts of the unit.

C-1.2 Proper operation of the fire alarm sounder being critical and essential, tests/performance criteria specified in **C-3** shall apply to these devices.

NOTE — It is the primary function of CIE to raise an effective alarm in response to the operation of a trigger device by automatically switching on alarm sounder at the protected premises, by indicating where the trigger device is situated and in certain cases, by transmitting a fire alarm signal to remote locations. Automatic indication of those faults directly affecting the primary function of the equipment is required. It is necessary to specify routine testing scheme and routine test frequency (time interval between tests). It is understood, however, that testing routine will vary widely with the type of equipment or system. All technical information (instruction manual, operational data, wiring and connection diagrams, provision of special and standard facilities and other relevant information) shall be provided with the CIE. Compatibility with other components/parts of fire alarm system shall be ensured.

The test specified under performance clause are type tests only that neither ensure uniformity of quality in production or remove the essentiality of regular inspection and maintenance which are essential for reliable operation.

CIE shall be appropriately labelled to include model number or code, number of zones, fixed or modular design and address of manufacturer/supplier.

C-2 PERFORMANCE**C-2.1 Control and Indicating Equipment (CIE)**

Prior to conducting each of environmental tests given in **C-2.3**, the equipment is preconditioned (*see C-2.1.1*)

and checked for functional tests (*see C-2.2*) and after undergoing each of the environmental tests given in **C-2.3** (after being stabilized), the equipment is tested for functional tests (*see C-2.2*).

C-2.1.1 Preconditioning and Recovery

Before and after each environmental test, the temperature of the equipment shall be allowed to stabilize for at least 3 h to room ambient between 15 °C and 37 °C and relative humidity lying between 45 and 85 percent. The ambient temperature and humidity shall be substantially constant during precondition, during recovery and while a functional test is carried out.

C-2.2 Functional Test

These tests shall consist of the following operation in sequence:

- a) Operate momentarily a trigger device (automatic detector/MCP) from any zone to ensure correct functioning;
- b) Operate alarm silencing switch to ensure correct functioning;
- c) Operate another trigger device (detector/MCP) from another zone to ensure correct functioning of CIE and sector/zonal panel, in case of big/sectorized equipment;
- d) Operate reset control to ensure correct functioning;
- e) Check the audible and visible warnings given on disconnection of normal (mains) power; and
- f) Restore the equipment to quiescent condition.

C-2.3 Test Environments

The equipment shall be subjected to the following test environment.

C-2.3.1 Dry Heat Environment

The equipment/electronic panels shall be introduced into the chamber/oven which shall be at the ambient temperature of the laboratory (*see C-2.1.1*). The

chamber shall then be adjusted to temperature of 45 °C to 50 °C and 40 to 45 percent relative humidity. The rate of temperature rise shall not exceed 1 °C/min. After the temperature equilibrium in the chamber has been reached, the equipment shall be exposed to these conditions for 16 h continuously.

C-2.3.2 Damp Heat Environment

The equipment/electronic panels shall be introduced into a chamber which shall be maintained at a temperature of 45 ± 3 °C and relative humidity of 90 to 95 percent. The equipment shall be exposed to these conditions for 16 h continuously.

C-2.3.3 Cold Environment

The equipment/electronic panel while being at the ambient temperature of the laboratory, shall be introduced into the chamber, which shall also be at that temperature at the start. The temperature shall then be lowered to 0 ± 5 °C at the rate not exceeding 1 °C/min. The equipment shall be exposed to cold environment for a period of 16 h after the temperature stability has been reached. The equipment shall remain in the chamber during the recovery period (of 3 h) with cooling off.

C-2.3.4 Vibrations

The equipment mounted on vibrating table in its normal operating position and by its normal fastenings shall be subjected to vibrations as given in IS 2175.

C-2.4 Inspection and Performance Requirements

After each environmental test, the equipment shall be opened and inspected for faults consequential to that test. The equipment/panels shall be considered satisfactory, if:

- a) no damage is revealed during inspection which is a result of the faulty design or workmanship; and
- b) each operation made during the functional tests specified above cause the equipment/panel to operate normally.

C-2.5 Operational Test

With CIE in its quiescent condition for 20 h, the cumulative effect of the operation of trigger device shall be applied to each zone in succession, the audible alarm being silenced between each operation where this facility is provided. The equipment shall be considered satisfactory if all fire alarms supposed to be initiated by the operation of a trigger device functions normally and no-fault warning is given as a result of this test. In successive zone activation process for a control panel having more than three zones, heat detectors, smoke detectors and MCPs shall be used unless otherwise

specified. The following two conditions shall be observed:

- a) At least one zone shall be activated by a type of trigger device; and
- b) MCP shall be mounted and operated as intended while heat and smoke detectors shall be mounted (at least once) in hot air tunnel (as per IS 2175) and smoke tunnel (as per IS 11360), respectively and brought into operation by essentially slow buildup of temperature and smoke concentration. Rate of rise of temperature shall be 3 °C/min and rate of smoke build up shall be less than 0.2 dB/m as prescribed in the standard for measuring the response of smoke detectors.

C-3 FIRE ALARM SOUNDER

C-3.1 Continuous Normal Operation

The fire alarm sounder shall be able to operate continuously for a period of at least 50 min without damage or malfunction. The sound output (peak value) shall not vary by more than ± 5 dB(A) during this operation.

C-3.2 Sound Level/Characteristics

The sound level (peak value) shall be not less than 65 dB(A) and not more than 120 dB(A) when measured at a distance of 1.5 m (measured in audiometric chamber).

C-3.3 Environmental Stresses

Construction and housing of sounder shall be such as to afford protection against fouling by dust and damage by other environmental stresses.

- a) *Dust* — One device shall be exposed to dust test as described in IS 11360.
- b) *Corrosion* — One device shall be suspended in corrosive atmosphere of SO₂ as described in IS 2175.
- c) *Vibrations* — One device shall be mounted on vibrating table and shall be subjected to vibrations as per IS 2175.
- d) *Climatic conditions* — One device shall be exposed to dry heat, damp heat and cold environment as per C-2.3.1 to C-2.3.3 above.

After each environment stress test, device shall be inspected for faults consequential to that test and its sound output measured. Device shall be considered satisfactory if no damage is revealed and operates normally without output variation greater than ± 5 dB (A).

ANNEX D

(Clause 11.10)

TYPICAL OCCUPATIONAL NOISE LEVELS

Sl No.	Location	Decibel Level db
(1)	(2)	(3)
i)	Business occupancies	55
ii)	Educational occupancies	45
iii)	Industrial occupancies	80
iv)	Institutional occupancies	50
v)	Mercantile occupancies	40
vi)	Mechanical rooms	85
vii)	Piers and water surrounded structures	40
viii)	Places of assembly	55
ix)	Residential occupancies	35
x)	Storage occupancies	30
xi)	Thoroughfare and high density urban	7
xii)	Thoroughfare and medium density urban	55
xiii)	Thoroughfare and rural and suburban	40
xiv)	Tower occupancies	35
xv)	Underground structures and windowless buildings	40
xvi)	Vehicles and vessels	50
xvii)	Conferences and meeting rooms	40-45
xviii)	Exhibition halls	63-73
xix)	Commercial kitchens	65-75
xx)	Boiler areas	75-85
xxi)	Air conditioning plant	85-90
xxii)	Cafeterias	68-78
xxiii)	Railway stations	75-85
xiv)	Shopping malls	70-75
xv)	Sports halls	70-80

ANNEX E*(Foreword)***COMMITTEE COMPOSITION**

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This Indian Standard has been developed from Doc No.: CED 22 (14642).

Amendments Issued Since Publication

Amend No.	Date of Issue	Text Affected

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Published by BIS, New Delhi